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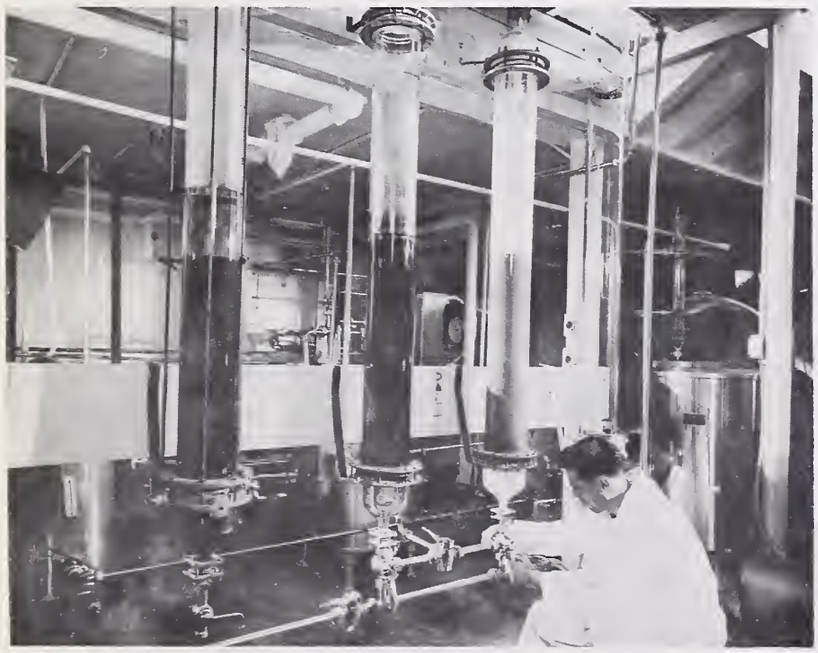
Radiostrontium, one of the products of nuclear fallout, can remain in the soil and contaminate pasture grasses for many years. Since cows secrete in their milk only about 1 percent of the strontium they consume each day the processing of milk to remove radiostrontium would be necessary only in the event of dangerously high fallout levels. NCD9-54

Removing Radiostrontium from Milk

Radiostrontium--the long-lasting contaminant that results from fallout--can be removed from milk. In the laboratory, up to 98 percent of this radioactive element (strontium 90) has been removed from milk by increasing the acidity of the milk, passing it through ion-exchange resins, and then restoring the milk's original acidity. Now at USDA's Agricultural Research Center, Beltsville, Maryland, the method is being adapted and perfected on a pilot-plant scale to assure a safe and palatable milk supply in the event of an emergency.

Scientists have succeeded in removing up to 98 percent of radiostrontium from milk by applying known ion-exchange principles, using modern, complex synthetic resins. Here USDA food technologist, David Easterly times the rate of milk flow through a laboratory-size column containing ion-exchange resin. N-42620



Here the same process, advanced from laboratory to pilot-plant scale, is operated by dairy technologist William Mattingly. Milk is pumped from the tank at the right through one of the large columns packed with an ion-exchange resin. When the column becomes saturated with radiostrontium, it is washed and recharged for another run. Meanwhile, milk is being processed through another one of the columns. This pilot plant processes 100 gallons of milk an hour. N-43175

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The program for radiostrontium removal is being developed jointly by the Public Health Service of the Department of Health, Education, and Welfare, the Atomic Energy Commission, and the Agricultural Research Service of the U. S. Department of Agriculture. The processes under development are an extension of certain fundamental principles discovered by the Department of Agriculture of Canada, Ottawa, and the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Radiostrontium is removed from milk by the well-known ion-exchange principle, whereby a substance can be altered in chemical composition by bringing it into contact with another substance with which it can exchange certain ions. In this case, milk contaminated by radiostrontium is passed through a column containing a complex synthetic resin. The strontium ions in the milk change places with calcium ions on the resin.

The steps in the process are as follows: Cold, raw milk containing radiostronium is (1) treated with dilute citric acid (a common food component) to facilitate removal of the isotope; (2) passed through ion-exchange resins charged with proper proportions of calcium, potassium, sodium, and magnesium so that these useful minerals in milk are not affected and only the strontium dilute potassium and (6) passed small amount of w

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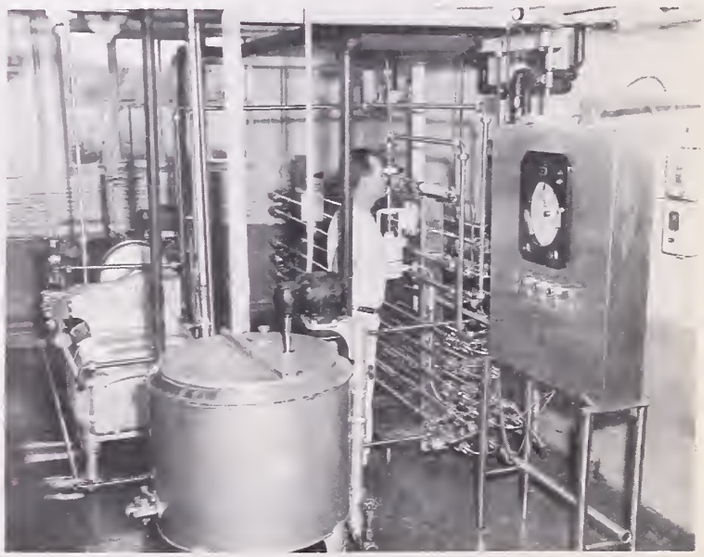
Scientists found that for efficient radiostrontium removal, they had to increase the acidity of the milk. Here USDA dairy technologist, Homer E. Walter adds dilute citric acid to the milk preparatory to passing it through the "fixed-bed" ion-exchange resin column. By thus lowering the milk's pH from its normal 6.6 to 5.4, the percentage of radiostrontium removed by the process is raised from 60 to 98. N-42628

Milk samples are then given an acidity reading to make sure that the desired level of pH 5.4 has been achieved before putting the milk through the resin column. N-42629

After passing through the ion-exchange resin (see photo on first page), the decontaminated milk is neutralized. Here Dr. L. F. Edmondson, who heads the strontium-removal program, is adding a measured amount of dilute potassium hydroxide to restore the milk to pH 6.6. N-42638



The milk is then homogenized and pasteurized using equipment similar to that in any small dairy. Here dairy technologist, Arthur M. Sadler is pasteurizing the decontaminated milk. N-42639

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Two ways of processing the milk through the resin are under test. In the "fixed-bed" method, the ion-exchange resin remains in large, fixed columns. After the milk has passed through a column, the resin must be washed with the four mineral salts in proper proportions. This removes the radiostrontium and regenerates the resin for the next run. The "movable-bed" method uses patented, electronically controlled equipment in which fresh resin is moved in contact with the milk, and is washed and regenerated continuously.

The facilities at Beltsville include modern laboratories with chemical and electronic equipment for testing and monitoring the procedures used. The milk is sampled and radiostronium counts are made before and after it is passed through the charged resin. The calcium, potassium, sodium, and magnesium content of the milk is also determined in order to guard against changes in composition and to ensure that the resin is properly charged.

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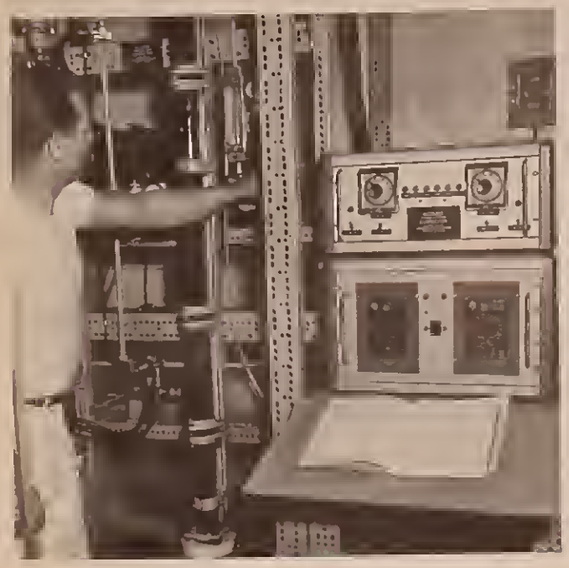
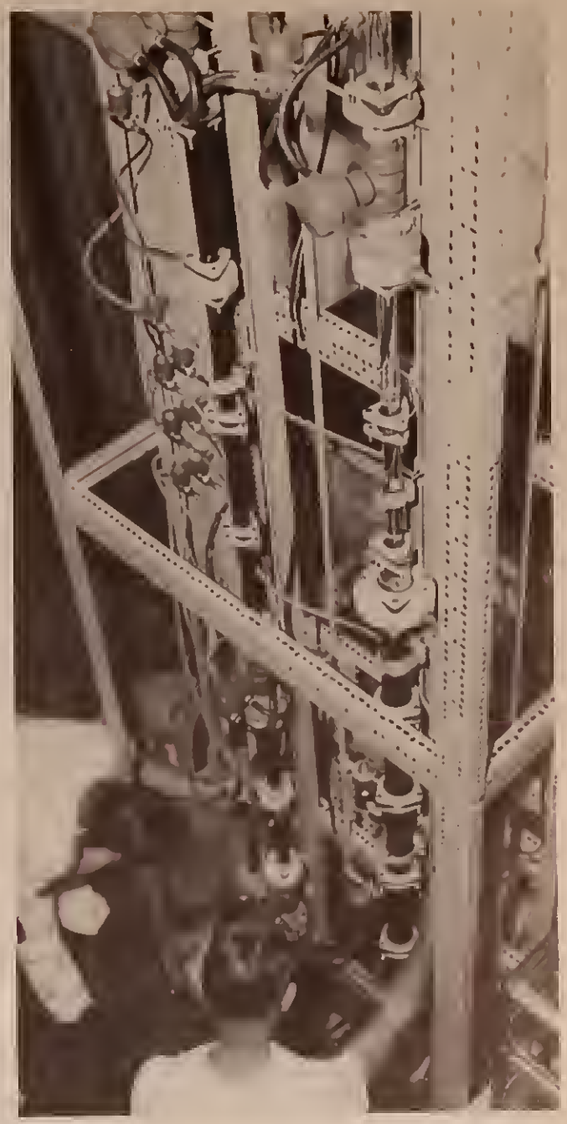
"Moving-Bed" Resin Contactor

Although proved effective by both laboratory and pilot-plant experiments, the "fixed-bed" method is not the only, or even necessarily the best, way of removing radiostrontium from milk by ion exchange. Among other approaches under investigations is the "moving-bed" method, whereby the resin is pumped through a continuous column in one direction and brought into contact with the milk being pumped in the opposite direction. This has the advantage of constantly presenting fresh resin to the milk. The continuous contactor shown here, which operates in this way, is now under investigation as part of the radiostrontium-removal program. Electronically controlled and completely automatic, this machine removes the isotope from the milk and cleans and regenerates the resin all in one continuous process. N-42635

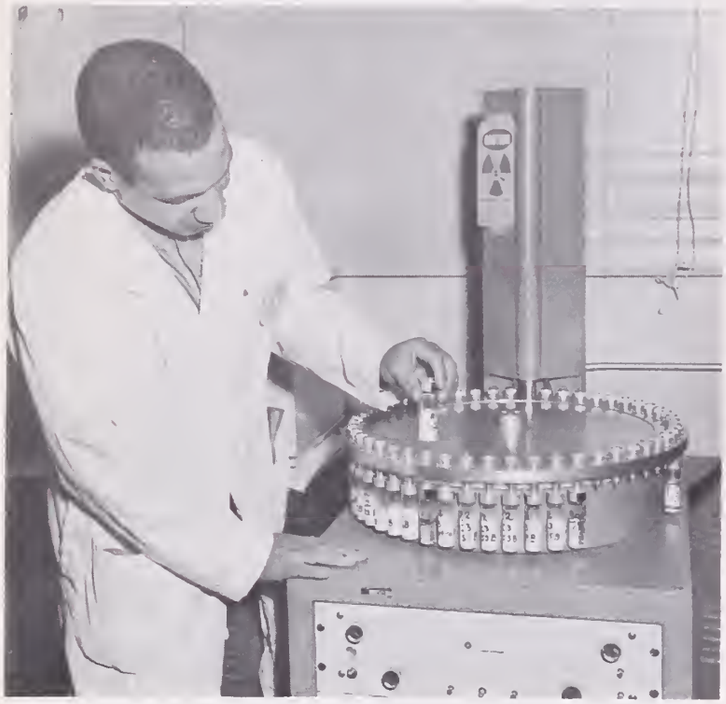


This electronic instrument panel, operated by Arthur M. Sadler, acts as the brain of the contactor, controlling its operations. N-42636



Behind the Scenes

Milk from cows injected with radiostrontium is used for this experimental work. Also, "pure" milk samples, to which the isotope is added directly, are used. Here Public Health Service officer Jesse Harris injects capsule of radiostrontium into cow's throat. N-43055



Radiostrontium contamination is determined through gamma-ray emission before and after milk samples are processed. Jesse Harris loads the single-channel automatic scintillation counter which counts and automatically records data on 50 samples at a time.
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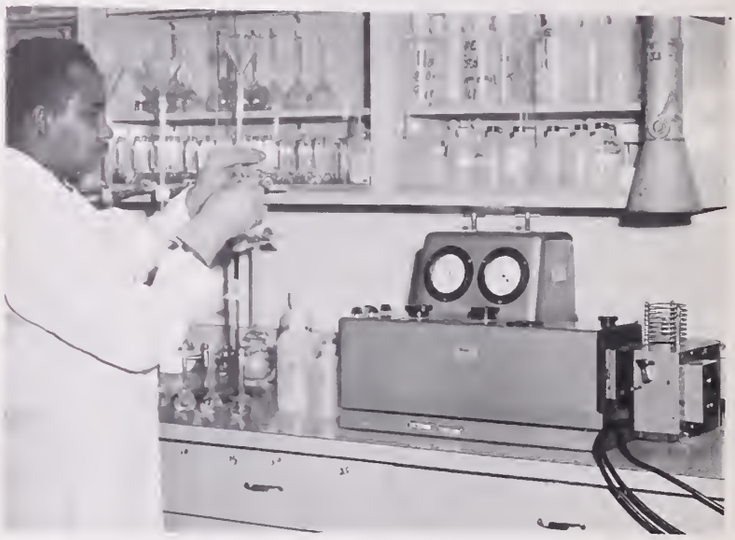

ARS chemist Fred W. Douglas, Jr., determines the calcium, potassium, sodium, and magnesium content in experimental milk samples. The resin must be treated with proportionate amounts of these minerals.
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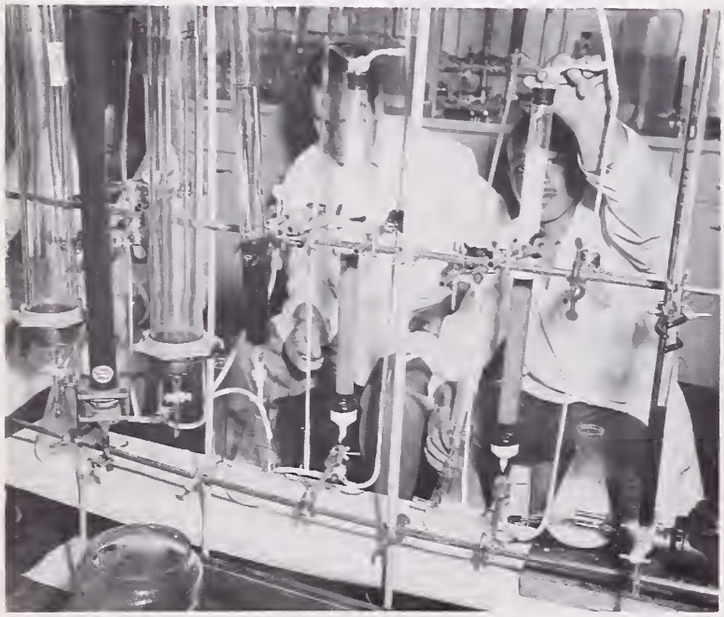

Test runs on how well the resin is functioning are made in the laboratory. Adjustments in charging may be made based on these runs. David Easterly times the passage of milk through the resin as Jesse Harris directs the milk flow into cylinder. N-42619

Normal milk put through all the steps that would be required to remove radiostrontium is sampled by trained tasters to make sure that the process induces no objectionable flavor changes. Criticisms by these tasters guide researchers in perfecting the processing operation.
N-39217